

foundland by the 28th. This storm was particularly severe, causing loss of life and destroying crops and property of immense aggregate value.

In August, 1887, two severe storms advanced northward from the West Indies. One apparently originated to the eastward of the Windward Islands and moved northwestward to about N. 22°, W. 63°, by the 16th; moving slightly north of west, the depression was central on the 19th off the east coast of southern Florida, whence it recurved northward and followed the course of the Gulf Stream until the 23d, on which date it was central in N. 50°, W. 31°. During the passage of this storm along the coast of the United States it was attended by hurricanes of exceptional violence. During this month the presence of a second storm was indicated to the eastward of the Windward Islands on the 19th; by the 20th the centre of depression had moved west-northwest to about N. 22°, W. 66°, whence it is traced to N. 26°, W. 76°, by the 21st. On this

date south to west gales of hurricane force prevailed over the eastern portion of the Bahama Islands; in the vicinity of the thirtieth parallel fresh easterly gales were reported, while off the Florida coast strong northerly gales prevailed. During the 22d and 23d the storm recurved slowly northward, with a marked decrease in energy; by the 24th it had advanced to N. 32°, W. 76°, and during its northeast passage along the course of the Gulf Stream during the next two days it was attended by hurricanes of great violence.

By extending telegraphic communication with Bermuda and availing ourselves of that now existing in the West Indies it would become possible for this Service to greatly extend its usefulness to the shipping interests of the country, and with proper arrangements for the distribution of storm signals, warnings could be issued which in a single year might save from destruction property the value of which would exceed the cost of maintaining this Service for many years.

NORTH ATLANTIC STORMS FOR NOVEMBER, 1888 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the depressions that appeared over the north Atlantic Ocean during November, 1888, are shown on chart i. These paths have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels, received through the co-operation of the Hydrographic Office, Navy Department; and the "New York Herald Weather Service."

Eleven depressions have been traced, of which six advanced north of east over or near Newfoundland; two first appeared northeast of the Windward Islands; and three apparently originated over mid-ocean near the fiftieth parallel. The depressions traced north of the forty-fifth parallel generally followed normal east-northeast to northeast tracks, the exceptions being numbers 1 and 6, which assumed southerly paths after having advanced to the vicinity of the thirtieth meridian. An important storm which moved westward north of the West Indies to the Bahamas is thence traced northward off the coast of the United States as a low area. A second storm of tropical origin moved from northeast of the Windward Islands and apparently dissipated west of the Azores. The severest disturbances of the month occurred over mid-ocean, from the 6th to the 12th, inclusive, attending depressions 2, 3, and 5, and off the coast of the United States from the 21st to the 27th, attending depression 8 (low area vi).

In November, 1887, fourteen depressions were traced, of which two were continuations of storms charted for October, 1887; three traversed the ocean from coast to coast; one first appeared east of the fifteenth meridian; five passed eastward over or to the northward of Newfoundland; one apparently originated south of Nova Scotia; and three were given probable paths northward from the sub-tropical region. The general direction of movement of the depressions was east-northeast, and their tracks were rather evenly distributed along and north of the trans-Atlantic routes.

In November, 1888, the depressions traced corresponded in number with the average for November during the past four years. Over mid-ocean along the trans-Atlantic routes the weather was generally stormy, except during the latter half of the third decade. In the vicinity of the British Isles there was a succession of heavy gales during the first half of the month, and from the 24th to the 30th, inclusive; while off the coast of the United States the month was characterized by the very destructive storms of the third decade. Considered as a whole, the weather over the north Atlantic during the month was seasonable, and the depressions, while possessing great energy, did not exceed in intensity those traced for November during preceding years.

In the following descriptions of the depressions traced positions are given in degrees, latitude and longitude, except in

cases where from twenty-five to thirty-five minutes have been cited, when they are given in degrees and half degrees.

1.—This depression was apparently a continuation of number 11, traced for October, 1888, and was central on the 1st south of Greenland near the fifty-fifth parallel, whence it moved northeast to the thirtieth meridian by the 2d, where it assumed a southeast course and advanced to the southern extremity of Ireland by the 4th, after which it passed eastward over the continent of Europe. This depression was attended by moderate gales and exhibited lowest pressure on the 3d, when a reading of 29.44 (747.8) was reported at noon, Greenwich time.

2.—This depression was central over Newfoundland on the 4th, from whence it moved rapidly eastward, and is last located south of the British Isles under date of the 8th. This storm was attended throughout by fresh to strong gales, and closely followed the trans-Atlantic steamer routes over a greater part of the ocean. Subsequent to the 8th the storm centre apparently recurved to the northward under the influence of depression number 3 which occupied mid-ocean during the 8th and 9th.

3.—This depression (low area ii) passed along the southern coast of Newfoundland during the 7th, and by the 8th had advanced to about N. 52°, W. 40°, and thence moved northeast to the thirtieth meridian by the 10th, after which it disappeared north of the region of observation. This storm augmented in energy during its advance over the ocean, and on the 9th barometer readings ranging to 28.41 (721.6) were reported near its centre, and from the 8th to 10th, inclusive, gales attaining hurricane force were encountered over mid-ocean.

4.—This depression is first charted northeast of the Windward Islands under date of the 5th, and is thence traced northeast to about N. 35°, W. 45° by noon, Greenwich time, of the 8th, after which its course cannot be determined with reports at hand. The storm possessed great energy, and its advance was attended by violent gales.

5.—This depression was apparently a subsidiary development to depression number 3, and is first located in about N. 49°, W. 22°, under date of the 11th, when strong to whole gales and pressure falling below 29.00 (737) were reported. By the 12th the storm-centre had advanced to the westward of the British Isles, where minimum pressure falling below 28.50 (724), and strong to whole gales, were reported. Subsequent to the 12th the depression apparently recurved to the northward under the influence of depression number 6, which occupied the ocean to the westward.

6.—This depression (low area iii) advanced from the Gulf of Saint Lawrence over northern Newfoundland and at noon, Greenwich time, of the 12th was central in about N. 52°, W. 43°, and from thence moved east-northeast to the thirty-second meridian by the 13th, where it remained nearly sta-

tionary until the 14th, when it recurved southward to the fifty-second parallel, where it was central on the 15th. By the 16th the storm-centre had moved northeast to the fifty-sixth parallel, after which it disappeared north of the region of observation. This storm increased in energy as it advanced eastward, and from the 12th to the 15th, inclusive, occasioned strong to whole gales over mid-ocean along the trans-Atlantic routes.

7.—This depression (low area iv) was central on the morning of the 17th off the southern coast of Newfoundland, without evidence of marked energy, from which locality it passed northeast and disappeared north of the fiftieth parallel.

8.—This storm (number vi) was a hurricane of tropical origin. It is first located northeast of the Windward Islands under date of the 17th; from this position it is given an approximate path westward to the Bahama Islands, where it arrived on the 22d; during that and the following date the storm-centre recurved slowly to the northward, and, pursuing an abnormal northerly course, advanced to the south New England coast by the night of the 25-26th, after which it moved slowly along the New England coast, over eastern Maine, New Brunswick, and the southern part of the Gulf of Saint Lawrence to the vicinity of Cape Race, N. F., by the 30th. This storm was attended by very destructive gales off the coast of the United States from the 21st to the 27th, inclusive. On the 22d its influence extended to the fortieth parallel, and after its recurve over the Bahama Islands it augmented in energy until the 26th, when minimum pressure falling below 29.00 (737.0) was reported, after which there was a marked diminution in strength until the 30th, when the depression exhibited small energy. Storms of this class at this season generally follow the trend of the Gulf Stream after recurving to the northward. In the present instance the abnormal westerly movement may possibly be due to the very high barometric pressure which prevailed over and south of Newfoundland during the advance of the storm northward from the Bahamas. On the 26th there was a gradient of about two inches between the storm-centre's position and southern Newfoundland; subsequent to which date the storm gradually lost energy and a marked decrease in pressure occurred over and near Newfoundland. The conditions attending the unusual course of this storm give color to the belief that a storm's course is largely governed by the movements and position of areas of high pressure. Some of the most destructive storms noted along the Atlantic coast of the United States have appeared as depressions deflected westward to, or near, the coast by some undefined cause, which possibly may have been areas of high pressure located over, and south of, Newfoundland.

9.—This depression (low area v) moved rapidly northeastward from the Gulf of Saint Lawrence, where it was central on the 20th, to about N. 56°, W. 38° by the 21st, after which it advanced slowly east-northeast and disappeared in the vicinity of the twentieth meridian after the 23d, attended until the 22d, inclusive, by strong to whole gales.

10.—This depression first appeared over mid-ocean on the 23d, and was, apparently, a subsidiary development of depression number 9. Moving east-northeast the centre of depression disappeared north of the British Isles after the 25th, its passage being attended by strong to whole gales.

11.—This depression was apparently central about ten degrees west of the British Isles on the 26th, and by the 28th had advanced to the southwest extremity of Ireland, after which it probably recurved northward. This storm, in connection with number 10, caused low pressure to prevail over the British Isles during the last seven days of the month, and

occasioned fresh to strong gales westward over the ocean to the fortieth meridian.

OCEAN ICE IN NOVEMBER.

No ice was reported during the month. In 1882, 1883, and 1887, none was reported. In 1886, only one berg, fifty to sixty feet high, was observed on the 2d in N. 45° 20', W. 45° 26'. In 1885, the only iceberg reported was observed in N. 48°, W. 51° 10'. In 1884, several icebergs were seen in N. 45° 56', W. 52° 38'.

FOG IN NOVEMBER.

The limits of fog-belts to the westward of the fortieth meridian are shown on chart i by dotted shading. In the vicinity of the Banks of Newfoundland no fog was reported until the 17th, after which it occurred on six days; for October, 1888, it was reported on eleven days, and for November, 1887, fourteen days. Between the fifty-fifth and sixty-fifth meridians fog was reported for a total of seven days as compared with two days for October, 1888, and three days for November, 1887. To the westward of the sixty-fifth meridian fog was reported on seven days as compared with five days for October, 1888, and three days for November, 1887. From the above it will be seen that when compared with November, 1887, there was a marked deficiency in the number of fog-banks reported near Newfoundland, while to the southward of Nova Scotia and off the coast of the United States there was a decided increase in the number of days on which fog was reported.

As compared with the chart of the preceding month slight changes are shown in the southern limits of the fog-belts, while in November, 1887, fog was reported about one degree farther south in the vicinity of the Grand Banks than in the corresponding month of 1888.

On the several days for which fog was reported near Newfoundland the presence of an area of low pressure was shown to the west or northwest, except on the 18th when fog was encountered with variable winds and rising barometer following the passage to the northward of a storm-centre. Between the fifty-fifth and sixty-fifth meridians the development of fog attended the passage to the northward of areas of low pressure. Off the coast of the United States fog followed the passage of areas of low pressure eastward over the Gulf of Saint Lawrence, except during the 9th and 10th, when a depression of considerable strength advanced from the Mississippi Valley to the Saint Lawrence Valley, and on the 15th and 26th, when depressions were central off the middle Atlantic coast.

The following are limits of fog-areas on the north Atlantic Ocean during November, 1888, as reported by shipmasters:

Entered.				Cleared.				Entered.				Cleared.				
Date.	Lat.	N.	Lon.	Lat.	N.	Lon.	Lat.	N.	Lon.	Date.	Lat.	N.	Lon.	Lat.	N.	Lon.
3	49	00	62	20	49	27	60	50	20	47	16	47	00	46	46	48
6	36	57	75	50	4	57	75	50	20	44	55	49	05	44	12	53
6	Sandy Hook.			Off Barnegat.				21	42	50	60	58	42	40	62	10
6	40	37	72	00	Sandy Hook.				26	40	44	67	31	40	32	68
7	42	36	65	24	42	35	66	06	27-28	46	08	55	11	45	30	58
7	36	00	75	00	36	50	74	45	28	43	57	52	44	43	27	56
9-10	40	45	68	43	40	26	73	50	27-29	46	00	54	00	42	40	60
10	Nantucket Shoals			Sandy Hook.				28-29	46	30	47	36	44	07	57	10
15-16	40	35	69	30	40	28	69	16	28-29	45	22	52	38	43	30	58
16	42	36	66	52	42	34	67	04	28-29	44	00	53	00	43	00	60
16-17	42	49	60	18	42	37	63	23	28-29	46	05	52	50	45	05	60
17	44	58	53	06	44	48	54	04	28-30	Dense fog at St. John's, N. F.			43	00	60	
17	Off south coast of Newfoundland.							29-30	45	00	48	30	43	00	53	00
17-18	47	34	50	20	48	30	43	50	29	44	14	56	00	43	40	58

TEMPERATURE OF THE AIR (expressed in degrees, Fahrenheit).

The distribution of mean temperature over the United States and Canada for November, 1888, is exhibited on chart ii by dotted isotherms. In the table of miscellaneous meteorological data the monthly mean temperatures and the departures from the normal are given for stations of the Signal Service. The figures opposite the names of the geographical districts in the columns for